ABSTRACTS

THIRTY-FIFTH ANNUAL MEETING AND SYMPOSIUM

THE DESERT TORTOISE COUNCIL

Doubletree Hotel, Ontario, CA
February 25–28, 2010

(Abstracts arranged alphabetically by last name of first author)
*Speaker, if not the first author listed

Defenders of Wildlife 2010 Abstract: Desert Tortoise

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Defenders of Wildlife first launched its locally-based California Desert Campaign in 2005. This work focused on the Western Mojave Desert, which is currently undergoing the most intense development pressure. Desert Tortoise work is a key component for Defenders. We have established a permanent presence in the California desert to work with the public, local governments, and management agencies. We have staff based in both Sacramento and Joshua Tree to accomplish this objective.

The California Desert is under tremendous pressure from renewable energy proposals. Defenders is committed to protecting the natural habitat of the California Desert. We have hired additional staff, Jeff Aardahl, to work on renewable proposals. America needs to get away from burning the fossil fuels that are polluting our planet and causing global warming. Renewable power from solar and wind are key elements in the transition to a clean-energy future, but we must make sure that renewable energy development doesn't also ruin irreplaceable landscapes such as the scenic Mojave desert, or impact sensitive wildlife such as desert tortoises, burrowing owl, Mohave ground squirrel and migratory birds.

Defenders work on renewable energy projects in the California Desert includes solar thermal, photovoltaic, geothermal, and wind projects. The environmental values and biological integrity of much of the California Desert Conservation Area (CDCA) is at risk because of recent commercial interest in building and operating industrial-scale solar and wind energy projects. Beginning in 2007 and continuing through 2010, commercial solar and wind energy companies filed over 130 right of way applications with the Bureau of Land Management for solar and wind energy projects covering one-million acres of public land in the CDCA. This abrupt interest in using public lands for solar and

wind energy production coincided with two renewable energy utilization mandates from the State of California in 2006 and 2008.

In addition, Defenders, in an effort to reach out to Latino communities, have translated our educational brochures into Spanish both in print and on our website. We also have participated in a Native American Lands Conservancy Symposium, Raven Management Group, Mohave Ground Squirrel Conservation Plan, the Desert Managers' Group, Desert Tortoise Education Group, and the Desert Tortoise Recovery Plan.

Defenders is also working on climate change adaptation. This work includes land conservation planning, wildlife linkages and sponsoring the third annual Climate Change Seminar on March 12.

Impacts of Anthropogenic Nitrogen Deposition on Invasive Species and Fire Risk in California Deserts

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Invasive species have had major impacts on the California deserts, having such high productivity in some regions that they may both exclude native vegetation and be responsible for increased fire frequency. One of the anthropogenic factors that increases productivity of annual vegetation is nitrogen deposition that originates from urban (oxidized N, primarily from automobile emissions) and agricultural (reduced N) areas. Most of the N pollution occurs as dry deposition that accumulates on plant and soil surfaces and is available for plant uptake in mineral form at the beginning of the rainy season. The amounts of N deposition are as high as 16 kg N ha^{-1} yr^{-1} in the Coachella Valley, declining to background levels of <2 kg ha^{-1} yr^{-1} in the eastern Mojave and Sonoran Deserts. We used three approaches to test the impacts of N deposition. We 1) measured annual vegetation response to N along a N deposition gradient from 3-12 kg N ha^{-1} yr^{-1} (east to west) at Joshua tree National Park, 2) fertilized plots at four sites in the Park at levels of 0, 5 and 30 kg N ha^{-1} yr^{-1}, and 3) used a biogeochemical model, DayCent, to model the productivity of annual vegetation under varying precipitation and N deposition, and to assess the risk for fire assuming at least 1 T/ha of fine fuel is needed to carry a fire. We measured the responses of native and invasive plant species at the field sites over 5 years and in an experimental garden under varying soil moisture levels to parameterize the DayCent model. We also assessed diversity of native herbaceous vegetation in response to changes in invasive species in the field sites.

The dominant invasive species were *Schismus barbatus* and *Erodium cicutarium* at the lower elevations in creosote bush scrub (CB), and *Bromus madritensis* at the higher elevations in pinyon-juniper woodland (PJ). Some 90 species of native herbaceous species were recorded in fertilized plots over the 5 years. Each of the two fertilized

vegetation types were located in a relatively high and a low N deposition area. Exotic grass biomass increased significantly with 30 kg N/ha at three of the four sites during a year with moderate precipitation, and under 5 kg N/ha at two sites during a year with high precipitation. The response of native forbs to fertilizer was related to the amount of exotic grass present initially. The richness of native forbs declined with fertilization at a site with high initial exotic grass cover, but native richness and cover increased with fertilization at a site with low grass cover. Sites with low air pollution were not necessarily the sites with lowest invasive cover, as soil texture (rockiness and clay) also controls ability of invasive species to colonize and the N supply to plants, and further work is underway to test the relationship between soil texture and invasive species dominance.

The DayCent model showed that fire risk, calculated as the probability that annual biomass exceeds the fire threshold of 1 T/ha, increased with increasing N and precipitation, and was also controlled by soil texture. Critical loads of N deposition were determined as the amount of N deposition at the point when fire risk began to increase exponentially. Average critical loads for all soil types and precipitation < 21 cm/yr, representing the majority of our study region, were 3.2 and 3.9 kg N/ha for CB and PJ, respectively. Fire risks approached their maximum at 9.3 and 8.7 kg N/ha in CB and PJ; precipitation is the driver of fire above these N deposition levels. Levels of N deposition at the maximum fire risk load, a mean value of 9 kg ha^{-1} yr^{-1}, occur over 1.5% of the California deserts, mainly in the western Mojave and Coachella Valley, while the minimum critical load, 3.6 kg ha^{-1} yr^{-1}, occur over 32% of the deserts. This indicates that one-third of the desert is potentially subject to increased productivity of invasive species because of N deposition, coupled with decreased native diversity and increased fires. Vegetation recovery from fire is slow in deserts, and burned areas are often dominated by exotic annuals for decades after a burn. Additional work is underway to determine the relationship of past fire occurrence with areas of varying N deposition. Control of N deposition from air pollution may be an important management goal in reducing productivity of invasive grasses and their negative effects on desert ecosystems.

Continuing Efforts to Protect and Recover the Desert Tortoise

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For over a dozen years, the Center for Biological Diversity has focused its desert tortoise conservation and recovery efforts first in the California Desert Conservation Area (CDCA) and now expanded into Nevada, Utah and Arizona through advocacy, participation in administrative processes and, when necessary, litigation. Using the best available science, the Center has supported increased protection for the desert tortoise as a stepping stone towards desperately needed recovery of the species. Habitat protection for desert tortoise also protects innumerable other species, both rare and common that make the iconic western deserts their home. Our campaigns have changed the dialogue

for desert tortoise conservation and resulted in on-the-ground actions from ORV route designation review in key tortoise habitat, to improvements in tortoise translocation efforts, to increasing meaningful conservation strategies for tortoise. Looking forward, these efforts will be even more important as we work to protect the desert tortoise and its remaining habitat from destruction and fragmentation threatened by the glut of currently proposed renewable energy projects across the southwestern states.

We still believe that more protection and recovery efforts need to be focused on the desert tortoise because of the continuing and troubling population declines. Updates on the current legal challenges including the BLM's CDCA plan amendments and related actions and the Arizona strip case will be discussed. The on-going tragic failures of the Fort Irwin "first phase" translocation and our efforts to carefully craft renewable energy projects to avoid impacts to desert tortoise throughout its range will be reviewed. Our National Monument or Conservation Area campaigns for Gold Butte and the upper Las Vegas Wash will be highlighted as a model for desert tortoise conservation. Other ORV issues, water issues and development plans will also be discussed.

Progress Report on the Desert Tortoise from the Desert Tortoise Recovery Office, U.S. Fish and Wildlife Service

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No Abstract available.

Effects of Sahara Mustard, *Brassica tournefortii*, on a Desert Landscape

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Given the abundance of non-native species invading wildland habitats, managers need to employ informed triage to focus control efforts on weeds with the greatest potential for negative impacts. My objective was to determine the level of threat Sahara mustard, *Brassica tournefortii,* represents to meeting regional goals for protecting biodiversity. Sahara mustard has spread throughout much of the Mojave and lower Sonoran Deserts. It has occurred in southern California's Coachella Valley for nearly 80 years, punctuated by years of extremely high abundance following high rainfall. In those years the mustard has clear negative impacts on the native flora. Using mustard removal experiments I identified reductions in native plant reproduction, shifting composition increasingly toward Sahara mustard while decreasing the fraction of native species.

Without control measures the long-term impacts to desert biodiversity will be an increasing decline in native annual plants, with potential broad trophic impacts. High between-year variance in precipitation may be a key to maintaining biodiversity as the mustard is less abundant in drier years. Without control, the fate of Sahara mustard and the desert's biodiversity may rest on a changing climate. Drier conditions will keep the mustard from becoming dominant but will likely have other negative consequences on the native flora and fauna.

Renewable Energy Development and Desert Tortoise Conservation: Is Industrial Development of the Desert Compatible with Survival and Recovery?

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The Center for Biological Diversity has consistently advocated for the enforcement and expansion of protections for the threatened desert tortoise in the media, the administrative process and, when necessary, through litigation for over 20 years. The Center remains focused on science-based advocacy to ensure that land use planning and management on public lands as well as site specific decisions on both public and private lands provide effective protection for the desert tortoise and other imperiled species that will support recovery. To that end, the Center focuses our efforts on using existing environmental laws, including NEPA and ESA as well as state laws, to ensure that public agencies prioritize the survival and recovery of listed species in their management of public lands and in funding or carrying out projects.

As of September 2009, there were over 150 proposals for large industrial-scale renewable energy projects pending in the California Desert alone with dozens more proposed in Nevada, Arizona and Utah within the range of the listed population of the desert tortoise. A subset of about 18 of these projects (12 in the California Desert), called the "fast track" projects, are racing to be permitted and "shovel ready" by the end of 2010 to secure federal stimulus grant funding. In addition, new utility line proposals to service new generation facilities have the potential to further fragment habitat and act as a magnet drawing development into inappropriate areas.

The solar proposals on public lands in the CDCA alone (about 63 applications) cover over 500,000 acres, including many thousands of acres of occupied desert tortoise habitat. The scale of individual projects is unprecedented with many proposals covering 4,000-6,000 acres or even up to 10,000 acres of contiguous lands. The proposed projects run the gamut from previously disturbed private lands formerly used for farming in the desert to intact high quality occupied desert tortoise habitat on public lands. At least one wind generation proposal would impact over 1,500 acres of occupied desert tortoise critical habitat on Daggett ridge in the Ord-Rodman DWMA near a long term desert tortoise study site.

The Center is concerned that direct impacts to tortoises and habitat, as well as indirect and cumulative impacts from multiple projects, may undermine ecosystem integrity causing the collapse of subpopulations across the range. One example of an areas of concern is the Ivanpah Valley, much of which was identified for desert tortoise conservation in the 1994 Recovery Plan (see map at page 41) and supports a diverse and biologically rich suite of plants and animals, including the threatened desert tortoise. Presently, five large solar projects are proposed in the Ivanpah Valley, two in the northern Ivanpah Valley in California and three on the eastern side of the valley in Nevada. After taking a detailed look at the biological resources of northern Ivanpah Valley, including new information from surveys conducted by the solar companies that want to develop the area, it is clear that this area should be secured for long-term conservation and recovery of the desert tortoise and other species. Indeed, once again, we can see the foresight and accuracy of those scientists who drafted the 1994 Desert Tortoise Recovery Plan which identified this area for protection for the benefit of the desert tortoise. Unfortunately the BLM declined to follow the direction of the 1994 Recovery Plan in managing the public lands and excluded large areas of the Ivanpah Valley from protection in the DWMA, as a result, the Center and other conservation groups have needed to step up to fight for protection in this area.

As many of you know, the Center for Biological Diversity has also worked diligently to press government agencies to take the threat of global warming seriously, to utilize existing laws and enact new laws to move us towards significant reductions in greenhouse gas emissions. The Obama administration and the State of California have recently taken significant steps in that direction which we applaud.

The need to replace energy sources that emit large amounts of greenhouse gases is clear. We need to develop renewable energy *but we need to do it right.* We need to put large industrial-scale projects in *appropriate* places not in areas where they will displace significant populations of desert tortoise, destroy habitat and highly functioning ecosystems. Certainly some compromises will need to be made at the margins, but siting of large scale industrial facilities must take into account the facts on the ground, not only the preferred design of the developers. Alternative sites and alternative ways of meeting energy demand, including conservation and distributed renewable energy development, must all be fully explored as well.

Planning efforts by the BLM, state, and local agencies for the California Desert never contemplated this level of large scale industrial development, and, as a result, no planning was done. As a result, while many project proposals are moving forward in a scatter shot fashion and sprawling across the landscape, the BLM is at the same time undertaking planning efforts to find areas (or zones) to group projects near existing or approved transmission and to the extent possible in areas that are already disturbed. We applaud the BLM's new planning effort but fear it may be far too late if projects are approved piecemeal and "zones" are created by the momentum of industry lobbying instead of by rational planning principles. As those who have studied the desert well know, the impacts to the land and habitat are long term – if not permanent— even where there is funding for restoration efforts and the will to undertake them. Before any more

desert tortoise habitat is lost, thoughtful and careful environmental review and planning must be completed.

Finally, there is also a new planning effort to support desert tortoise recovery through mitigation funds that will be acquired from large industrial scale development in the desert. The Renewable Energy Action Team ("REAT") which includes BLM, FWS, CDFG, and CEC, is currently developing a conservation plan, the Desert Renewable Energy Conservation Plan ("DRECP"), that will identify high priority land acquisitions and recovery actions to help coordinate and potentiate future mitigation efforts. The Center applauds any efforts to increase recovery actions for the desert tortoise and provide more protection of critical habitat and other conservation lands, and to increase the land base that is protected for conservation. To that end, the Center intends to work closely with the agencies to develop a robust science-based plan with meaningful enforceable protections for many species across the desert landscape. However, *mitigation cannot replace conservation.* First and foremost, impacts to high quality occupied desert tortoise habitat must be avoided. Only after all avoidance measures have been explored and put in place (including alternative siting where necessary) should mitigation measures be implemented.

In sum, the Center for Biological Diversity supports renewable energy development in the right places which can be identified through an open public process using the best available science and good planning principles. The Center will continue to advocate for the protection of the desert tortoise and all imperiled species on both the local and regional level and advocate for science-based efforts to recover this keystone species of the southwestern deserts.

A Model of the Invasion and Establishment of Sahara Mustard (*Brassica tournefortii*) in the Western Sonoran Desert

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We studied the invasion and establishment of Sahara mustard, *Brassica tournefortii* Goan, at a 4.66 km^2 site in the Chemehuevi Valley of the western Sonoran Desert, California, USA. We used mixed data sets of photographs, transects for biomass of annuals, and densities of *B. tournefortii* collected at irregular intervals between 1979 and 2009. We suggest that *B. tournefortii* may have been present along the main route of travel, a highway, in low numbers in the late 1970s, and invaded the site from the highway and along a major microphyll woodland wash. In 1999 *B. tournefortii* density ranged from 0.55 plants/m^2 at the highway edge to 0 per transect at ~1700 m from the highway. By 2009, *B. tournefortii* density ranged from 33 plants/m^2 at the highway to 1.59 plants/m^2 ~1700 m from the highway. In addition, *B. tournefortii* had become established throughout the valley.

To develop a predictive model for invasibility of this region by *B. tournefortii*, we evaluated relationships of surficial geology/soils, habitat type, and distance to the highway on *B. tournefortii* density in 1999 and 2009. *Brassica tournefortii* densities differed significantly by surficial geology/soils and distances to the highway. During the initial invasion, significant predictor variables were proximity to the highway and to the microphyll woodland wash, as well as number of nearby washlets. However, once *B. tournefortii* was well established, proximity to the highway and number of washlets were the only significant predictor variables. Microhabitats also influenced density of *B. tournefortii*. *Brassica tournefortii* densities were higher under shrubs in washlets than in open desert under shrubs or intershrub spaces. Overall, *B. tournefortii* thrives in disturbed areas along road edges, in poorly developed soils, and on young geological surfaces. It is highly successful in naturally disturbed areas, such as within shrubs in washes and washlets. The ability of *B. tournefortii* to rapidly colonize and become established in the desert Southwest poses severe threats to the well-being of desert ecosystems.

Highway 58 Fence Study Reloaded:
Effectiveness of a Highway Barrier Fence after 19 Years

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Roads and highways pose a threat to many vertebrates due to natural movements and dispersal patterns of these animals. In some cases, this mortality may be compensatory, but in others the rates of mortality may be high enough to cause population declines. Barrier fences, if properly designed and maintained, can effectively mitigate against such mortality, and if they do, they can be viable mitigations to the impacts ofsolar and wind energy developments. We conducted surveys for desert tortoise sign within 1.6 km of the edge of Highway 58, where a barrier fence was constructed in 1990, and Highway 395, where no tortoise barrier fence exists. We compared the results to similar surveys conducted in 1991 and 1994. In 2009, we documented a decline by 83% in tortoise sign, and by inference, tortoise relative density, within 1.6 km of both highways. However, we also documented an increase in the number of burrows and proportion of sign occurring within 400 m of the edge of fenced Hwy 58 since 1991. In 2009, there was more sign within 200 m of fenced Hwy 58 compared to unfenced Hwy 395. Even after 19 years of the fence being in place, there is still a road effect; however that effect appears to have diminished. The amount of habitat "reclaimed" by tortoises along 1.6 km of Highway 58 is equivalent to 30 hectares of habitat not directly affected by the highway.

Is Translocation a Viable Option for Desert Tortoises: Measuring Short- and Medium-term Effects of a Large-scale Translocation Project

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Translocation is a highly controversial management strategy, because success of most projects is relatively low. More troubling is that translocations of threatened, endangered, and sensitive species have resulted in lower success rates than other groups. Translocation of desert tortoises was a tool approved to mitigate the acquisition of 110,000 acres for the expansion of Fort Irwin to facilitate more realistic training scenarios. Tortoises are being translocated from two areas: the Southern Expansion Area (23,000 acres) and the Western Expansion Area (69,500 acres). We are studying six primary measures of success (survival, dispersion, burrow use, reproduction, genetic assimilation, and habitat use) using up to 216 translocated, 108 resident, and 109 control animals. We are also comparing various modes of translocation (soft-release, hard-release, pens, and short versus long-distance). Preliminary trends revealed by some of these studies will be reported.

Reducing Raven Predation on Desert Tortoises: Does Removing Nests Prevent Ravens from Continuing to Nest?

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The common raven is an important predatory species that is hampering the recovery of threatened desert tortoise populations in the Mojave Desert. Habitat Conservation Plans and Biological Opinions for alternative energy and other developments usually include stipulations designed to reduce the probability that a development will facilitate an increase in raven presence and their predation on nearby tortoise populations. One of those conditions is the removal of raven nests. Here I report on the experimental removal of raven nests to determine if this is a viable management option. For three years, nests were searched for and removed on the 13-km^2 Hyundai Automotive Test Site Facility. Nests were also monitored within approximately 1.6 km of the perimeter to serve as references. A total of 35 to 62 raptor nests were observed each year. Thirty-eight (12.7 per year) were removed from the test site. A total of 53% were rebuilt within 1- 3 months of when the originals were removed and a few were removed more than once in a season. Annual nest removals resulted in 44% fewer nests occurring on the site. During the same time, there was a 15% reduction in nests off site,

where we did not remove nests. This indicates that birds probably did not simply move into the area surrounding the test site to nest, but rather skipped nesting altogether for the year. Annual nest removals did reduce the number of ravens nesting in the area, but the removals would have little effect if not coupled with other actions.

Management of Desert Tortoise Habitat on Public Lands Managed by the Bureau of Land Management – Nevada

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The BLM administers about 4.5 million acres of desert tortoise habitat in Clark, Lincoln, and Nye counties in Nevada of which 1,085,000 acres are designated as Critical Habitat. The Battle Mountain, Ely, and Southern Nevada District offices coordinate and conduct the majority of BLM's management activities for desert tortoise. The following are highlights from NV BLM's 2009 accomplishments. The BLM has successfully created a 20-year mineral withdrawal on 24 Areas of Critical Environmental Concern (ACECs) totaling nearly 945,000 acres in Clark and Nye counties in southern Nevada. Additionally, BLM is working with Partners in Conservation and the Southern Nevada Site Stewardship Program to monitor designated roads in desert tortoise ACECs over the next two years. This effort will reduce and repair resource injuries across 700,000 acres. The NV BLM continues to implement recovery actions including: (a) monitoring locations for desert tortoise habitat conditions and desert tortoise populations in Lincoln Co.; (b) reclaiming over 17 miles of roads and (c) installing over 15 miles of fencing at numerous locations that were being continually disturbed by motorized vehicles; (d) successfully obtaining competitive funding from the Mojave Desert Institute to create about 13 miles of fuel breaks in desert tortoise habitat to prevent large habitat losses due to fire; and (e) continued implementation of the Ely District Resource Management Plan that includes creating management plans for three ACECs within the next three years. Section 7 consultation remains a major workload for the Districts. Wildfires in desert tortoise habitat will continue to receive priority response; this includes emergency stabilization and restoration plans developed to rehabilitate the burned areas as quickly as possible. The BLM is continuing to monitor post-fire vegetation treatments.

San Diego's Renewable Energy Future is Bright

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San Diego Gas & Electric Company (SDG&E) is committed to providing safe, reliable energy to our customers in the most environmentally responsible manner

possible. Using the power of the sun, wind and geothermal sources are ways that SDG&E is fulfilling this commitment. SDG&E's programs and services help promote energy-efficiency, sustainability, and renewable energy solutions.

SDG&E supports the state's priority of making California the nation's leader in solar energy. Our regional energy plan is a balanced plan that includes energy-efficiency and demand-response programs, more energy from renewable sources, as well as new electric transmission and generation. We will meet the state requirement of delivering 20 percent of the power from renewable sources by this year, and 33 percent by 2020 as required through an executive order issued by Governor Arnold Schwarzenegger.

With the California Public Utilities Commission's ("CPUC") approval, up to $250 million will be invested in solar installations throughout the greater San Diego area over the next five years as part of San Diego's largest solar initiative. This innovative program will spark a partnership between businesses, municipalities, and institutions to dramatically increase the use of photovoltaic (PV) tracking technology at shopping centers, schools, open places and landfills.

SDG&E has a 20-year contract with Stirling Energy Systems' (SES) to purchase up to 900 megawatts of solar energy generated by up to 36,000 SunCatcher dishes spread across ten square miles in the Imperial Valley. This will be one of the world's largest solar power projects. SDG&E has signed other contracts and continues to solicit and review several thousand megawatts of proposed generation facilities to deliver energy from various sources including solar trough technology, wind, geothermal, and biomas.

One of the difficulties encountered by the renewable energy providers is having adequate transmission capacity for delivering their energy to market. Without a delivery source the energy providers are not able to secure adequate funding. SDG&E has recognized this issue and is seeking to permit and construct a new high-voltage transmission line between San Diego and Imperial Valley called the Sunrise Powerlink. The Sunrise Powerlink is a key element of SDG&E's regional energy plan to improve the reliability of the power grid and increase the use of renewable energy. The 120-mile transmission line is expected to be completed in 2012 and will deliver new supplies of needed electricity to homes and businesses and connect the region to clean solar, wind and geothermal projects located east of San Diego.

The future looks bright for renewable power in San Diego. Vast supplies of solar, wind and geothermal energy are sitting untapped in eastern San Diego County and the sunny deserts of Imperial Valley. Together, these regions could become a leading producer of renewable power and help reduce polluting greenhouse gas emissions in California.

Update on Desert Tortoise Protection Efforts by Western Watersheds Project

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Western Watersheds Project (WWP) works to protect and conserve the public lands, wildlife, and natural resources of the American West through education, public policy initiatives and litigation. In October 2008, WWP and WildEarth Guardians petitioned the Secretary of the Interior to list the Sonoran desert tortoise population as a Distinct Population Segment under the Endangered Species Act and to designate Critical Habitat. On August 28, 2009 the USFWS issued a positive 90-day finding on that petition. The Sonoran desert tortoise occurs in southwest Arizona and northern Mexico. The USFWS found that Sonoran desert tortoises qualify as a distinct population, different from other tortoises found in the Mojave Desert west of the Colorado River that were federally listed in 1990. The USFWS finding also addressed the unlisted population of Mojave type desert tortoises that live in the Black Mountains in northern Arizona. The USFWS determined that the Sonoran desert tortoises may be threatened by all five factors the agency uses in deciding whether a species qualifies for Endangered Species Act protection: 1) habitat loss and destruction; 2) overutilization; 3) disease or predation; 4) inadequate legal protections; and 5) other factors. Under the Act, the tortoises needed to qualify under a minimum of just one of these factors. The full list of threats noted in the 90-day finding include: habitat loss from livestock grazing, urbanization, border activities, off-road vehicles, roads, mining, harm to individual tortoises from shooting, collection for pets or food, diseases such as upper respiratory tract disease, shell disease, and other pathogens; increased predation by ravens, coyotes, and feral dogs; inadequate legal protections, including on federal and state public lands; altered fire patterns due to exotic weeds; crushing and killing of tortoises by off-road vehicle users; and prolonged drought, exacerbated by the climate crisis. WWP and WildEarth guardians are working with USFWS to ensure that the one year status review triggered by the 90-day finding is completed in a timely manner.

WWP is currently engaged in litigation with the Bureau of Land Management (BLM) over cattle grazing on the Sonoran Desert National Monument. WWP's litigation on the Sonoran Desert National Monument hopes to attain improved interim management for desert tortoise habitat pending the completion of the Monument Resource Management Plan. Elsewhere in Arizona, WWP has been protesting proposed grazing decisions within desert tortoise habitat based on BLM Determinations of NEPA Adequacy tiered to Environmental Impacts Statements completed over two decades ago.

WWP continues its efforts to conserve listed Mojave desert tortoise populations and to ensure that recovery measures are based on best available science. WWP is challenging an experimental restoration project proposed within Mojave desert tortoise habitat in Arizona, Utah, and Nevada where the BLM is proposing using non-native

vegetation. WWP is concerned that effects to tortoise and other habitats were not properly considered. WWP is actively involved in reviewing many of the industrial-scale renewable energy projects that have been proposed in desert tortoise habitat throughout the Mojave Desert. In addition to massive direct loss of habitat, these projects threaten to further fragment habitat and disrupt connectivity between the evolutionarily significant units identified in the 1994 Recovery Plan.

STUDENT PAPER

Potential Conservation Benefits of Multiple Paternities in the Threatened Desert Tortoise, *Gopherus agassizii*

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Conservation of the desert tortoise (*Gopherus agassizii)* depends largely on maintaining the maximum amount of remaining genetic and individual diversity in the species. One of the factors which affect the expression of genetic variation is the number of sires whose genes are expressed in each clutch. Thus, understanding paternity patterns improves our ability to develop effective plans for tortoise conservation. We analyzed paternity of desert tortoise clutches at Edwards Air Force Base (EAFB) and Twentynine Palms Marine Corps Air Ground Combat Center (Twentynine Palms), California, during the course of ongoing headstart programs operating at both sites. We used 20 microsatellite loci to genotype mothers, neonates, and potential fathers encountered in the vicinity. We included nests with ≥3 neonates from which genotypes could be obtained in the paternity analysis. We used both conservative criteria (requiring evidence from 2 or more loci) and less rigid criteria (requiring evidence from only 1 locus) to estimate the incidence of multiple paternities at each site. At EAFB, 50 to 100% of the nests were sired by multiple males, and at Twentynine Palms 58 to 83% of nests showed evidence of multiple paternity. Desert tortoises clearly exhibit multiple paternities, which may have

important implications for their conservation, and raises interesting questions about female choice in this species.

Managing Desert Tortoise on California BLM lands: Can We Chart the Path to Recovery Amidst Renewable Energy Development?

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In 2009, the Bureau of Land Management (BLM) continued to work on projects such as tortoise translocations associated with Fort Irwin Expansion, signing Northern and Eastern Colorado desert routes (especially in the Chuckwalla Bench Desert Wildlife Management Area) as the first step in habitat restoration efforts, the in-depth tortoise study initiated in 2008, acquisitions of private land, and conducting desert tortoise surveys in several areas. We funded an evaluation of the effects of the Hwy 58 fencing on tortoise mortality and densities, 19 years post construction. Additionally, we have coordinated with US Fish and Wildlife Service on data needed for their spatial decision support system, a tool that will assist land mangers in assessing the benefits of different recovery actions for tortoise and help in the prioritization of these actions. However, most of our effort and time was focused on solar and wind energy projects. Industrial renewable energy development projects are of a size and scale that California BLM has not previously contemplated nor envisioned. We face a huge challenge of managing the public trust. With the potential loss of thousands of acres to a single use and the projected mitigation requirements and associated funding, we want to be strategic in how mitigation is applied to get the maximum benefit for the tortoise, and other wildlife species. While many argue that renewable energy will be the demise of the tortoise, we ask, "Could industrial renewable energy provide an unprecedented opportunity to implement suites of targeted recovery actions and actually move the tortoise towards recovery?" In coordination with Fish and Wildlife Service and California Department of Fish and Game, BLM is striving to chart that path.

Health, Behavior, and Survival of 158 Tortoises Translocated from Ft. Irwin: Year 2

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A sample of 158 desert tortoises from Ft. Irwin's Southern Expansion Area (SEA) was translocated in the spring of 2008 to four study plots located outside the SEA. Prior to translocation, tortoises were grouped into one of four health categories. Tortoises were monitored on a regular basis and have received comprehensive health evaluations during

each spring and fall. We evaluated the development of new diseases, survival, movement patterns, and changes in clinical signs of disease and trauma after translocation. These responses were compared among health categories, sexes, and release plots. Overall, there has been an increase in prevalence of mycoplasmosis (2.8–2.9% tortoises with positive or suspect ELISA tests for *Mycoplasma agassizii* in 2008; 4.9–9.2% in 2009). Deaths of translocated tortoises, primarily from predation, have remained high in 2008 (27.2%) and 2009 (23.5%), and death rates varied among plots. Movement parameters also differed among years, seasons, sexes, and plots. Tortoises have dispersed up to 12.5 km from their release sites, with a mean dispersal distance of 2.5 km. Our results provide evidence that tortoises have begun to settle and that increased activity levels are associated with increased risk of mortality. Future work will entail continued monitoring and health evaluations, analyzing clinical signs of disease and trauma, and quantifying differences in habitat among study plots. We place the preliminary results of this study in context with future translocation projects.

Illegal Collection of Desert Tortoises in the Sonoran Desert

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The expansion of human transportation infrastructure into desert tortoise (*Gopherus agassizii*) habitat in the Sonoran Desert has raised questions concerning the appropriate mitigation strategies to reduce impacts at the population level. While direct impacts (namely road-kill mortality and habitat loss) have been well documented, indirect impacts such as illegal tortoise collection have been insufficiently addressed. From a management perspective, it has become increasingly important to understand the cumulative impacts that roads have on tortoises. We estimated the probability of desert tortoise collection along three road categories to evaluate whether collection probabilities were related to road type. The predicted probability of a motorist detecting a desert tortoise was highest on maintained gravel roads and lowest on non-maintained gravel and paved roads. Given tortoise detection, motorist response varied by road type with the probability of tortoise collection highest on maintained gravel roads. We discuss the implications that these results have for comprehensive road mitigation strategies.

POSTER

Landscape-Level Habitat Models for Desert Tortoises in Southwestern Arizona

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The Arizona Game and Fish Department is developing a landscape-level habitat model to predict desert tortoise (*Gopherus agassizii*) occupancy on three military installations in southwestern Arizona (i.e., U.S. Army Yuma Proving Ground, Barry M. Goldwater Air Force Range, and Marine Corps Air Station, Yuma). These models will assist natural resource managers in identifying potential conflicts between desert tortoise conservation and maintaining the military's mission with the overall goal of reducing conflicts and mitigating the potential impacts of military training activities. We present preliminary results of our first year of research and the anticipated benefits of taking a landscape-level approach to desert tortoise conservation on these installations.

POSTER

Modeling Desert Tortoise Occupancy on the Florence Military Reservation, Pinal County, Arizona

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The Florence Military Reservation (FMR), located in Pinal County, Arizona serves as a desert training complex for the Arizona Army National Guard. The installation also provides habitat for desert tortoises (*Gopherus agassizii*). The goal of this study was to evaluate the distribution of desert tortoises within the FMR training area and develop recommendations to minimize impacts to tortoises while maintaining the National Guard's military readiness mission. We conducted standardized tortoise surveys on 228 3-ha survey plots and calculated occupancy estimates using a likelihood-based approach which allowed us to estimate the proportion of area occupied (PAO) as well as detection probabilities. We also examined the influence of site- and survey-specific covariates on detection probabilities and PAO. Detection probability was best modeled as a function of time, being highest during the early morning surveys (i.e., sunrise to 10am) and declined as the day progressed. The average detection probability across all the survey plots was 0.307 (range: 0.209 to 0.400; *SE* = 0.054). The overall PAO was estimated at 0.216 (*SE* = 0.055). Our results indicate that tortoises were 1.67 times more likely to occupy a plot with each caliche cave present. Desert tortoises were 0.45 and 0.35

times as likely to occupy a plot when roads and cattle sign were present, respectively. We discuss management recommendations for reducing impacts to desert tortoises on the FMR based on the results of this study.

2009 RECIPIENT OF THE DAVID J. MORAFKA MEMORIAL RESEARCH AWARD

The Prevalence and Distribution of *Mycoplasma agassizii* in the Texas Tortoise (*Gopherus berlanderii*)

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Upper respiratory tract disease (URTD) caused by *Mycoplasma agassizii* is characterized by ocular and nasal discharge, conjunctivitis, and decreased appetite and lethargy. Significant morbidity and mortality can be caused by the secondary effects of this disease including generalized malaise and decreased visual and olfactory function. URTD has been associated with major losses of free-ranging desert tortoises (*Gopherus agassizii*) and gopher tortoises (*Gopherus polyphemus*) in the United States. This has prompted investigation into the prevalence and distribution of the disease in the Texas tortoise (*Gopherus berlandieri*). Blood samples were taken from 40 Texas tortoises for detection of anti-mycoplasma antibodies by ELISA. Of the 40 tortoises, 11 were seropositive indicating that they had been exposed to mycoplasma and developed a detectable immune response. Twenty six of the tortoises were seronegative, and three were suspect for antibodies against *M. agassizii* on the ELISA test. Seropositive tortoises were found on both public and private lands in Cameron and Hidalgo counties of south Texas. Nasal lavage samples were collected for culture and detection of *Mycoplasma agassizii* gene sequences by polymerase chain reaction (PCR). Of the 35 tortoises that had nasal lavage performed, only one was positive on culture and PCR for *Mycoplasma* organisms.

Reproductive Nutrition Revisited

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We evaluated whether dietary nitrogen concentration, food consumption, and nitrogen consumption affect the reproductive output of female desert tortoises.

Reproductive output did not vary with the concentration of nitrogen (0.5 to 3.0%), but female size and condition affected reproductive output (e.g., clutch size, fecundity, egg size, clutch mass and clutch nitrogen content). Body reserves probably enabled some females to produce eggs while eating the low nitrogen diets (0.5 and 1.0% N). Neither nitrogen intake nor food intake affected reproductive output of the first (immediate) reproductive season, but reproductive output in the second year was correlated to nitrogen intake, especially nitrogen intake during the first year. These correlations correspond with vitellogenesis of the largest ovarian follicles before winter, although small follicles may also develop at this time. There appears to be a trade-off between current and future reproduction, especially with regards to nitrogen intake in spring. The highest food and nitrogen intakes occurred shortly after females oviposited, suggesting a constraint of current reproductive state on the nutrient intake that influences next year's reproductive output.

QuadState Local Governments Authority: A Partner in Desert Tortoise Recovery

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QuadState LGA continues to speak for and represent local governments in the Mojave and Sonoran Deserts. During the past year it has grown to eight counties, with the addition of La Paz County Arizona. During the past year we have remained engaged with the land management and wildlife agencies regarding both the Mojave and Sonoran Populations of desert tortoise.

Regarding the Mojave Population we await, like many others, the release of the reviewed and revised recovery plan. We look forward to working with the State and Federal agencies on implementation. Counties are actively engaged with the California Desert Managers Group, and have been accorded membership as public agencies in the Management Oversight Group. We participate in the Mojave Desert Initiative which covers the three eastern states, and we provide a conduit of information regarding wildlife and land rehabilitation between the State and Federal agencies and local governments. QuadState grew from a need by the counties for services and advice regarding tortoise, and other natural resources and public lands issues for which many lack staffing to cover. With current budget shortfalls, many may be less likely to directly participate in the future. QuadState and its three member counties from California were granted intervener status in the current litigation regarding the West Mojave, and we are participating with the Federal defendants on the case.

We remain concerned on several elements of the Recovery Plan revision, and hope the Fish and Wildlife Service addresses at least some of them, but will await release before reacting and commenting on what may or may not be in that document.

Regarding the Sonoran Population, Mohave County asked that we become engaged in the review regarding the petition to list, which is under FWS consideration at the present time. We have engaged the wildlife agencies regarding data and information so as to assist Arizona counties in responding to the petition. The addition of La Paz County to our organization is a direct result of the petition process and its desire to engage in the process in advance of decision-making. We have made other counties in Arizona aware of the petition.

We [the counties] look forward to developing partnerships and interface with the Arizona agencies and interagency organizations, and to continuing our relationship with the agencies in California, Nevada and Utah, so as to provide local governments with information; and to provide the agencies with local government's perspective on issues, policies and information.

The Desert Tortoise Conservation Center: A New Story

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In March 2009, the San Diego Zoo's Institute for Conservation Research, as a member of the Conservation Centers for Species Survival (C2S2), entered into a cooperative agreement with the US Fish and Wildlife Service (FWS), the Bureau of Land Management (BLM), and the Nevada Department of Wildlife (NDOW) to take over operations of the Desert Tortoise Conservation Center (DTCC) in Las Vegas, Nevada. Our main goal at the DTCC is to play a role in the conservation of the Mojave Desert ecosystem, including the recovery of the desert tortoise. To that end, the San Diego Zoo and its partners are changing the role of the DTCC from that of a transfer-and-holding facility to one that will support range-wide recovery efforts for the desert tortoise through conservation research, participation in on-the-ground recovery actions, training of biologists, and public education. The DTCC staff will share details of our first year on site. We have made improvements in husbandry and veterinary care, we have conducted a variety of medical tests and performed advanced veterinary procedures, and we have given the facility a face lift. In addition, we have gained community support through a volunteer/intern program, and we have conducted public education to improve the captive care of pet desert tortoises and to discourage people from removing wild desert tortoises from their native habitat. We have also established research protocols for translocation of desert tortoises back to the wild, and we are working with local agencies and organizations to collaborate on projects to improve the lives of desert tortoises everywhere. We are pleased to share the news with the desert tortoise community that the DTCC will soon have a new story to tell; one in which we can ensure that wild desert tortoises beat the odds and win the race to survive.

Tortoises Through the Lens (TTL): A Community-based Approach to Conservation

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Tortoise Through the Lens, TTL, is a community-based conservation action project; empowers high-desert youth by teaching them ecology, biology, and photography and guides them throughout the Mojave to photograph its beauty and species. The project is centered on the desert tortoise, so that the students can gain a deeper understanding of this desert icon and its plight, and can use their art towards conserving this threatened reptile.

The 20-minute presentation will consist of: 1) an introduction to the program, including how and why the program was developed; 2) how education can complement capacity building for youth; 3) what successes and lessons learned can be used to involve and engage non-traditional allies into conservation action; and 4) future efforts for TTL. The format will be a PowerPoint presentation, narrated by David Lamfrom. The presentation will also feature a photo gallery of some of the student's best work. Five minutes will be provided at the end of the program to allow for questions.

Timing is Everything for Renewable Energy

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Work on the 52 solar projects and 54 wind energy projects proposed for public lands is focused on applications seeking federal stimulus funding and on essential transmission line projects. These include nine solar projects, five wind energy projects, three geothermal projects and three transmission lines in the California desert. Most of these are located within desert tortoise habitat. The filing of so many applications in a short period of time created an unanticipated workload for all federal and state permitting agencies, and for the public utilities. Biological consultants, including desert tortoise experts, are stressed.

Conservation of existing habitat for the desert tortoise is a primary issue for nearly all renewable energy projects. An unprecedented amount of detailed information is being received. Many sites have had surprises, ranging from the finding of zero tortoises to the finding of nearly a hundred tortoises to the finding of 3,000 year old tortoise bones.

Relocation or translocation of tortoises from the development sites poses many difficult problems. Given that disease testing, surveys of recipient sites and extensive monitoring may be necessary, how can the tortoises be moved so that the project is "shovel ready" by December 2010? Should tortoises be moved in the fall or in a low rainfall year when little food is available?

The time frame to meet the funding deadline has led to high risk for the energy companies and great uncertainty on how to proceed. Desert tortoise mitigation and compensation issues remain as major obstacles. Substations and transmission capacity may not be available at the time the power plant is ready to start production. The federal bureaucracy is not well equipped to provide timely review. Renewable projects not on the fast track may experience significant delays in review of their plans, even though they may have a superior technology or may be located in places without desert tortoise habitat.

Shifting priorities, infeasible deadlines, lack of experienced staff and mounting opposition from many sources have created a chaotic scenario for biologists attempting to provide a thoughtful and reasoned approach to analysis of the project impacts on the desert tortoise. Regional planning is following, rather than leading, the review of projects. Decisions on the fast track projects will precede the federal Solar Energy Environmental Impact Statement and the California Desert Renewable Energy Conservation Plan. The analysis of cumulative impacts is particularly difficult. For example, preclusion of connectivity linkages between critical habitat units is a possibility.

Despite these challenges, agency biologists have a commitment to "do it right" and to suggest modifications that will conserve essential desert tortoise habitat for the long term. The public interest in conservation of wildlife, including the threatened desert tortoise, is equal to the public interest in achieving energy independence.

PG&E's Renewable Energy Program: Our Approach to Meeting the Challenge

Glen Lubcke, Senior Land Planner, Land and Environmental Management

Pacific Gas and Electric Company

Pacific Gas and Electric Company (PG&E) is the largest investor owned utility in California. There are approximately 20,000 employees who carry out PG&E's primary business—the transmission and delivery of energy. The company provides electricity and natural gas to about 15 million people throughout a 70,000-square-mile service area in northern and central California. Like all utilities in California, PG&E is working towards increasing its renewable energy portfolio and PG&E's portfolio is one of the cleanest in the nation. In our efforts to become an environmental leader, PG&E is actively engaged in many efforts of renewable energy exploration and acquisition in the western Mojave Desert. Examples of our efforts and involvement with renewable energy in the Mojave Desert include:

- The tracking and monitoring of privately-owned renewable energy plants that allow PG&E to sign Power Purchase Agreements (PPAs);
- Participation in regional planning efforts to develop Best Management Practices for the draft Desert Renewable Energy Conservation Plan Best Management Practices & Guidance Manual: Desert Renewable Energy Projects;
- Participation and involvement with the Renewable Energy Action Team (REAT);
- Tracking, monitoring, and participation of the BLM programmatic EIS for renewable energy on public lands;
- PG&E is actively involved with many stakeholder groups that include solar, energy, and environmental groups with a focus on coming up with practical solutions to minimize impacts on the environment;
- Participation with the California Transmission Planning Group to track and monitor the regional planning efforts for transmission lines and renewable energy generation; and
- Participation and involvement with RETI (Renewable Energy Transmission Initiative).

SCE Leading the Way in Renewable Energy

Milissa Marona, Project Manager

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If we equate kilometers to kilowatt-hours, then Southern California Edison (SCE) is the Lance Armstrong of renewable energy buyers. SCE buys more energy from renewable resources than any other utility in the U.S. About a hundred miles separate the Tehachapi wind farms from the Los Angeles basin. That's about two hours on the highway. Well, electricity needs a special super highway to travel on, and SCE is proposing to build it.

STUDENT PAPER: ORAL PRESENTATION AND POSTER

Bolson Tortoise (*Gopherus flavomarginatus*) Headstart in New Mexico, 2009

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Restoration of the endangered bolson tortoise (*Gopherus flavomarginatus*) in the United States is dependant on captive breeding and headstarting of young. Bolson tortoises presently occur in the wild only in a small region of the Chihuahuan Desert in Mexico; an area less than 100 miles across its broadest point (Tennesen 1985, Bury et al. 1988). Three known populations of bolsons now exist in the United States, two on

Turner ranches located in southern New Mexico, and 1 in a zoo setting located at the New Mexico Living Desert Zoo and Garden State Park near Carlsbad. Twenty five live on Turner's Armendaris Ranch and 38 juveniles live on Turner's Ladder Ranch. In 2009, 25 hatchlings were produced; 13 on the Turner ranches and 12 in Carlsbad. Since the transfer of the adults from the Appleton ranch in Arizona in 2006, various techniques have been used to increase the production of neonates, which eventually will be introduced experimentally into the wild to assess their survival. X-rays have proven to be particularly useful because they not only tell us the number of eggs each gravid female has, but also an estimated time of laying. On the Armendaris ranch during the summer of 2009, 10 females were x-rayed 4 times during the nesting season (May-July). Ninety percent were determined gravid for the first clutch and 70% for a second clutch. No females produced a third clutch. Two graduate students surveyed two 8.5 acre enclosures twice daily throughout the nesting season to locate natural nests; success was limited. Nests found were either protected with an 18x16in wooden box and 2x2ft chicken wire apron predator-proof enclosure or eggs were removed for indoor incubation. Three tortoises hatched as laid in one of these enclosures. X-rays determined 84 eggs total from gravid females on the Armendaris. Among these eggs, only 27 (32%) were located in the fenced enclosures. Of the 27 eggs, 19 (70%) were removed for artificial incubation and 8 (30%) were incubated naturally. Time of indoor incubation from eggs hatching ranged between 72–80 days and natural incubating ranged between 100–110 ±5 days. By this and similar field experiments, we will continue to refine techniques to obtain large numbers of hatchlings for future releases in the wild.

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Conservation Challenges of a Desert Tortoise Population at the Edge of its Range

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The Red Cliffs Desert Reserve (Reserve) is located in southwestern Utah at the northeastern extent of the tortoises range. The Division of Wildlife Resources has been monitoring tortoises in the Reserve since 1997. Population monitoring in 2009 indicates a population decline of tortoises throughout the Reserve since 1997. In 2003, an increased number of tortoises with clinical signs of URTD were observed along with an increased number of adult shells. In the summer of 2005, approximately 14,471 acres

burned within the Red Cliffs Desert Reserve. The Reserve is considered a highly threatened population due to its proximity to urban growth, small size, as well as human and stochastic threats (e.g., recreation, fire, disease, drought). We will discuss challenges that land managers face when managing a tortoise population at the edge of its range.

California's Fading Wildflowers: Lost Legacy and Biological Invasions

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Spanish explorers in the late 18th century found springtime coastal California covered with spectacular carpets of wildflowers. Nineteenth century botanists and naturalists describe flower fields across the central valley and interior southern California. Annual newspaper reports of identifiable sites such as Riverside (1885-1905) and the "Alter of San Pasqual" (Pasadena, 1885-1920), and "circle tour" localities (1920-2005) including the Arvin flower festival, Antelope Valley, Coachella Valley and Inland Empire, reveal that interior wildflower fields survived into the mid-20th century. California wildflowers were the basis of floral societies and the foundation of the New Year's Rose Parade in Pasadena. Summer coastal pastures, which were extensively burned by Native Americans, were not "grasslands" as translated from the original Spanish, but "*pasto*" and "*zacate*," interchangeable words that mean forage good for livestock. Spanish, Californio and early American settlers alike describe the California interior in the dry season as "*esteril*" or "barrens," an observation of desiccated and disarticulated native forbs that left little dry biomass.

Invasive annual grasses and forbs from the Mediterranean Basin and Middle East have devastated this nearly forgotten botanical heritage. Franciscan exotics *Brassica nigra* and *Avena fatua* had extensively displaced coastal forbfields by the Gold Rush, but flower fields in inland valleys and plains were displaced a century later by *Bromus madritensis*, *B. diandrus*, and *A. barbata*. Invasives such as *Erodium cicutarium*, *E. moschatum* and the clovers of *Trifolium and Medicago* coexisted with native forbs, while *Malva parviflora* and *Hordeum murinum* were limited to areas of chronic disturbance. Defenders of the perennial bunch-grassland (*Nassella)* model as the aboriginal vegetation baseline—a hypothesis deduced using space-for-time substitution by Fredrick Clements—built their case on "scientific" evidence that began in the mid-19th century. However the first botanists saw already widespread exotic grasslands, a classic case of the "shifting baseline syndrome"—the story being told is dependent on the baseline of choice. In this story, bunch grassland is assumed to have been replaced by exotic annuals due to overgrazing, but 19th century writings clearly show that bunch grasses were not important to the vegetation and that invasive species spread across California, far ahead of grazing. California wildflower pastures were displaced by invasive species without disturbance. The invasive species—fire feedback hypothesis in coastal California is refuted in view of Crespi's remarkable account (1769) of Native American burning in indigenous fuels, but merits consideration for interior barrens now covered with cured

exotic annual grassland. The role of grazing should be viewed in geological time scales because the evolution of the California flora coincided with diverse megafauna that exerted a cattle-like disturbance until the end of the Pleistocene. Packrat middens document that wildflowers have been part of California's heritage as conspecifics since at least the last glacial maximum, perhaps long before.

The wildflower flora was less affected by invasive species in the California deserts. The only widespread introduced species from the Franciscan mission period was *Erodium cicutarium* which likely spread across southeast California in the late 18th century. Descriptions of *Erodium cicutarium* coexistence with wildflowers by John C. Frémont and other mid-19th century naturalists and botanists in the central valley suggests that similar coexistence may have existed in the deserts. Wildflowers were described in the Mojave Desert by Frémont in the 1840s, and the early 20th century in local newspapers including reports of "circle tours" in the Los Angeles *Times* despite the rapid expansion of *Schismus barbatis* across the desert in the 1940s. While *Bromus rubens* first proliferated across coastal California in the 1890s, it was collected extensively in the Mojave Desert only by the 1930s, and did not become abundant until heavy rains fell from 1978 to 1983, the wettest 6-year period in instrumental records in southern California. After wet years vast carpets of red brome from 1978 to 1997 carried extensive fires (ca. 10,000 ha) and suppressed wildflowers. Dry years failed to produce good blooms. Extreme drought in 1989-1991 in the Sonoran Desert, and 1996-1997 in the Mojave Desert resulted in brome "crashes." Mass germination with the first fall rains was followed by mass mortality before reproductive maturity due to poor follow-up rains, destroying both grass cover and the seed bank. Unusually productive *Schismus barbatis* carried fires after wet years in the Coachella Valley in the 1990s. *Bromus rubens* survived best above 1200 m in western Joshua Tree National Park where it contributed to an 18,000 acre burn in 1999, a year after heavy El Niño rains in 1998. Since the 1990s wildflower blooms have again splashed across the desert, where brome has been extirpated at regional scales or greatly diminished. Historically unprecedented extreme drought produced another brome crash in 2002 (no rain fell in many areas of the desert for an entire year) was followed by a "once in a lifetime" spring bloom in 2005, after the wettest winter in instrumental records. Extraordinarily productive wildflowers (1-2 tons ha^{-1}) and native grasses (*Aristida, Hilaria*) fueled extensive fires in the NE Mojave Desert, eastern San Bernardino Mountains, and Joshua Tree National Park in 2005 and 2006 (60,000 ha). Fires are seldom fueled by *Brassica tournefortii*, which first proliferated in the lower deserts in the late 1970s, because its flammability is diminished by its coarse stem structure and open arrangement of stems compared to grasses. Once dry, stems also tumble with the first high winds. The future of the California deserts may be one of periodic invasion of brome after wet years and their replacement by native wildflowers after drought. Reconstruction of earthquake history along the Garlock fault near Mojave, using C-14 dates of charate, reveals that fires had infrequently burned creosote bush scrub over the past 7000 years of the Holocene. The desert was not "fire proof" before the arrival of invasive species.

California's wildflower heritage has been overlooked because of a flawed hypothesis that bunch grasses were pervasive in the past. We take for granted the rapidly

fading wildflower heritage because the perception of past vegetation among the scientific community and the public has been built upon this erroneous premise. This bunchgrass story has canalized us to perceive California ecosystems in a certain way, preventing us from observing, doubting, and searching for alternative evidence to construct alternative stories. California invasive grasses and forbs are productive and aggressive not because of intrinsic life traits, but because they are New World "goats on islands," without their Old World pathogens. The restoration of California's wildflower flora will require management strategies involving the entire landscape, with a historical perspective. Potential avenues for effective management and conservation include spring burning, seasonal grazing by domesticated livestock, and use of Old World pathogens as biological controls of California's invasive annual species.

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Head-starting Desert Tortoises at the Twentynine Palms Marine Base: 2009 Update

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The Desert Tortoise head-start hatchery-nursery facility at the Twentynine Palms Marine Base was established to research head-start methodology, including vertical transmission (mother to egg) of *Mycoplasma*-based disease (URTD). This question was abandoned following three years of unsuccessful location of wild females having clinical (visible) symptoms of URTD or positive ELISA or PRC tests, but several other questions are being studied. In collaboration with Dr. R. Murphy, we found that the incidence of multiple paternity within egg clutches is high, similar to earlier results from Edwards AFB. Since hatchling sex is determined not by their genes but by incubation temperature, we wondered whether something about the head-start facility may have influenced nest temperatures and thus the sex ratios of hatchlings. Dr G. Kuchling used endoscopy to determine the sex of about 30 juveniles each from 2006, 2007 and 2008 cohorts at TRACRS, and found that from 66% to over 95% of cohorts were females. Results to date are insufficient to test for a significant trend over time. Since 2006, hatching success, survivorship from hatchling to yearling, and survivorship from yearling to three years old have all been between 70 and 90 percent. Analyses of growth rates suggest that most juveniles hatched in the TRACRS facility, which receives supplemental "rain" to prolong growth of food plants, are growing about three or more times faster than do juveniles in "control" enclosures that get only natural rainfall. Projections of these

growth rates suggest that these juveniles may reach releasable size (estimated to be about 110 mm MCL) after a minimum of about seven years.

Shell Hardness Index and Rate of Shell Hardening in Desert Tortoises

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Heavy predation on hatchlings and juveniles of the threatened Desert Tortoise is apparently a major impediment to recovery of the species in the Mojave Desert. The shell of hatchlings remains soft and flexible for years, and hardening of the shell, along with increased size, is thought to improve predator resistance greatly. We used a tension-calibrated micrometer to measure shell hardness of 158 young tortoises with ages ranging from one to 17 years, from three desert sites in California. Shell Hardness Index (SHI) values exhibited considerable variation within age cohorts, and adjusting for size (MCL) variation within age cohorts did not reduce this variation in SHI. Shell hardness increased asymptotically with increasing age and increasing size. Juveniles having access to an extended supply of green desert annual plants due to experimental rain supplementation grew faster but exhibited softer shells than control (natural rainfall only) tortoises during their first year (but not in subsequent years) of life.

Conservation Activities to Benefit the Desert Tortoise: Educational Outreach, Land Management, and Habitat Improvement

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For the last 36 years the Desert Tortoise Preserve Committee, Inc. (DTPC) has focused its desert tortoise conservation and recovery efforts through educational outreach, land acquisition, active land management, and more recently, habitat improvement. Success in the campaign for the recovery of the desert tortoise can only result from these types of on-the-ground actions.

Last year approximately 10,000 people were contacted via educational presentations, public outreach events, and through contact with the Interpretive Naturalists staffed at the Desert Tortoise Research Natural Area (DTNA). Each contact helped spread the important message of conservation throughout the range of the imperiled desert tortoise.

The DTPC was awarded $89,000 in grant funding from the Off-Highway Motor Vehicle Recreation (OHMVR) Division for two ground operations projects in 2009. The bulk of the funding ($68,000) will be used to install desert tortoise exclusion fencing along three miles of the DTNA's boundary fence. The dramatic increase in traffic on roads near the DTNA necessitates this protective fencing. The remainder of the funding ($21,000) will be used to replace vandalized and weathered signs, sign newly fenced areas, and provide additional directional signage at major intersections near the DTNA.

The entrance to the DTNA, badly damaged by off-roading activities in recent years, was fenced in 2009. This fencing will prevent future impacts from vehicle trespass and allow the habitat in the area to recover naturally. The fencing also serves to make the entrance of the Natural Area more attractive to visitors.

The long-term goal of completing desert tortoise exclusion fencing along Harper Lake Road was accomplished in December of 2009. The DTPC's Harper Lake Road Fencing Project is the result of a successful multi-agency effort to ensure compliance of mitigation conditions under federal and state permits. The DTPC assumed fencing and monitoring commitments made by Luz Solar Partners Ltd VII and IX whose permits for the protection of the desert tortoise and its habitat were in default. But for the DTPC's role in fencing and monitoring Harper Lake Road, the road and impacts associated with the solar plant built in the 1980s would not have been mitigated.

The DTPC continued to focus heavily on improving the habitat at Camp "C". The five acres of habitat improvements (i.e. vertical mulch, horizontal mulch, and catchments) constructed in 2007 were regularly watered and monitored throughout the year and new practices were conducted on an additional 7.5 acres. The current status of the project and plans for an additional 17.5 acres of habitat improvement will be discussed.

The Pitfalls of Using Test Results for Decision-Making in Conservation Programs.

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The importance of disease risk assessments and disease screening for reintroduction and translocation programs is universally accepted and comprehensive tools are now available to guide the process. However, the traditional approach of developing a list of diseases of concern, testing release candidates for those diseases, and making release decisions based on the test results suffers from several fundamental problems. These problems are best illustrated by looking at two common scenarios where test results are used for decision-making in translocation and reintroduction programs.

The first scenario occurs when a population of apparently healthy animals is being screened to identify disease carriers, or those in the early (asymptomatic) stages of

disease, so they can be *excluded* from a release cohort. It is important to understand that most diagnostic tests are designed to detect an infectious agent (or the host response to an agent) in an animal showing clinical signs of disease. Diagnostic tests that have been validated for the host species in question will generally perform well in this situation, because animals with clinical signs are the ones most likely to have the disease agent. However, when the very same tests are applied to animals without clinical signs, as in our first scenario here, test performance will decline significantly (because animals without clinical signs are the ones least likely to have the agent). Poor test performance will be manifested as a high proportion of false positives in this situation, leading to misclassification errors that not only exclude valuable individuals from translocation programs, but sometimes result in euthanasia of perfectly healthy animals.

The second scenario occurs when a mixed population of healthy and diseased animals is being tested to verify that the apparently healthy individuals are test-negative (truly disease-free), so they can be *included* in a release cohort. Test performance will also be poor in this situation, but will be manifested as a high proportion of false negative results. This leads to misclassification of infected animals as uninfected, and therefore to the unintentional release of diseased individuals into the wild.

Additional problems occur when surveillance is only conducted on the source population. To adequately evaluate the risk posed by the presence of an agent in the source population, one needs to know whether the agent is also present in the destination population. However, it is seldom feasible to sample sufficient numbers of animals in the field to answer this question, and the same interpretive problems with surveillance tests described above would apply.

Using test results for decision-making in conservation programs requires a thorough understanding of these pitfalls and the tailoring of surveillance programs to the specific populations and questions at hand.

Arrival and Spread of *Brassica tournefortii* in Southwestern North America

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Brassica tournefortii ("Sahara mustard") has become an abundant annual weed in open dry areas, especially in sandy soil, through much of southwestern North America. In less than 90 years it is spread from an initial point of establishment in the Coachella Valley in Riverside County, California, to points as far distant as the Central Coast Range of San Benito County, California, El Paso, Texas, and the coast of southern Sonora, Mexico. It has also found its way into southwestern Utah and is continuing to spread north in the Coast Range and San Joaquin Valley of California. So far it is unrecorded from Inyo County, California. It now occupies an area that stretches some 1460 km NW to SE and c. 1300 km east-west. Yet, it has not stopped its spread, though in some areas it may have reached ecological limits.

Natural and Induced Antibodies in Experimentally Immunized Desert Tortoises (*Gopherus agassizii*): The Importance of Season and Gender

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Captive desert tortoises were immunized with ovalbumin (OVA) in Ribi's adjuvant to induce a humoral immune response, both before and after hibernation. We observed a significant mean increase in OVA-specific antibody, and a gender-by-season interaction in the ability of desert tortoises to make an induced immune response. We observed relatively high levels of pre-existing natural antibody to OVA in all tortoises, and levels varied among individuals. There was a significant, negative relationship between an animal's natural antibody titer and the maximum increase in induced antibody titers, and a significant, positive relationship between the magnitude of long-term elevations in OVA-specific antibody titers and the maximum increase in induced titers. Both natural and long-term elevations in induced antibody titers may be important elements of the tortoise immune system, with possible influences on the ecology and evolution of host-pathogen interactions. Reliance upon natural antibodies and the persistence of induced antibodies may be an adaptation in reptiles to defend themselves from pathogens in spite of their slow metabolic rates. In addition, natural and persistent antibodies may impact the interpretation of serological assays.

STUDENT PAPER

Digging Deeper: An Examination of Invasive Species and Nitrogen Deposition Effects on Aboveground Annual Forb Communities and Seed Banks in the California Deserts

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Invasive species pose a threat to natural communities around the globe. In southern California, desert ecosystems are experiencing altered nutrient cycles, increased fire frequency, and competitive effects from invading annual plants. Anthropogenic nitrogen deposition adds to the problem by artificially fertilizing the desert's low nutrient soils and creating a favorable environment for invaders. This degradation of habitat not only affects the vegetative community, but also the animals, such as the desert tortoise, that rely on it. In two related studies, we investigated the effects that invasive annual species and nitrogen deposition have on the aboveground community, as well as how that translates to the soil seed bank. A field study in the Colorado Desert using invasive removal and nitrogen additions demonstrates that both natives and invasives can respond positively to nitrogen additions, however invasive removal is required for natives to

obtain maximum benefits. A seed bank study at Joshua Tree National Park in sites fertilized with nitrogen shows that while nitrogen can have significant effects on the aboveground community, this is not always evident in the soil seed bank. It does, however, elicit important differences between sites, suggesting that factors such as background nitrogen deposition, soil rockiness, and historic levels of invasion may play an important role in seed bank composition. This work has important implications for conservation efforts, as well as emissions legislation. Understanding the combined effects of invasive species and nitrogen deposition on the desert landscape will help to create a more complete picture of how and why natural lands are being altered.

Desert Tortoise Recovery Efforts and Plans at Mojave National Preserve

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Mojave National Preserve encompasses 772,463 acres of designated habitat for desert tortoise (*Gopherus agassizii*) in the Fenner and Ivanpah valleys. In November, 2009 Chevron Inc. began removing the waste water pipeline from the Molycorp Mine site to former evaporation ponds on the Ivanpah dry lake bed. As part of the mitigation effort, Chevron is constructing a facility for research into juvenile headstarting as recommended in the Revised Recovery Plan Implementation Schedule section 3.3. An interagency panel of experts will select one of three highly qualified research groups to undertake this 15 year study. The primary criterion for selecting a research team is the potential to promote recovery of the species. An equally high priority is the ongoing mortality of tortoises along the 140 miles of paved roads through designated habitat. In the spring of 2009 we hired a contractor to conduct transects along Morningstar Mine Road and Essex Road following the methodology of Boarman and Sazaki (1996). Preliminary analyses suggest a population depression extends beyond 1.5 km from the edge of the road. We have requested funding for fencing critical highway sections. Our observations of traffic indicate that the roads connecting Las Vegas with populated areas to the south carry more traffic at a higher speed than other roads. Drivers on these roads have a 4% likelihood of spotting a tortoise in the road and warning signs appear to have no effect. Mojave National Preserve is continuing desert tortoise outreach and education efforts in partnership with the Desert Managers Group.

Desert Managers Group

Russell Scofield, DOI Coordinator

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The Desert Managers Group (DMG), an organization of federal, state, and county land managing agencies in the California deserts, focuses on coordinating and integrating desert tortoise recovery actions and monitoring efforts among managers and scientists across jurisdictional boundaries. A key to desert tortoise recovery is an informed public that understands and appreciates desert tortoise recovery. Now in its fourth year, the DMG is partnering with non-governmental organizations to continue its desert tortoise education program. Some goals of the program include standards based environmental education, brochures targeting specific audiences or topics, and media releases. The DMG is also coordinating ongoing regional assessments and science with renewable energy permitting plans such as the Desert Renewable Energy Conservation Plan and the Bureau of Land Management's Solar Programmatic Environmental Impact Statement.

Department of Fish and Game and the Desert Tortoise, Our State Reptile

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Since 1939, state laws have been in place in California to protect the desert tortoise. In August of 1989, the tortoise was officially listed by the Fish and Game Commission as threatened under the California Endangered Species Act (CESA). Sections 2080.1 and 2081 of the Fish and Game Code permit take for scientific, educational, management, or incidental take to an otherwise lawful activity provided the take is minimized and fully mitigated. In addition to an Incidental Take Permit, a Memorandum of Understanding (MOU) for Handling Tortoises is needed, and we must review the qualification of each person who applies for the MOU. The Department also issues Scientific Collecting Permits and MOUs for research and studies on desert tortoise; and permits for possession of Captive Tortoises.

The Department, through the CESA permitting process, and by other means, continues to acquire lands within recovery units. Along with the land acquired, the Department has also collected enhancement and endowment fees for management of the lands. Fencing has been installed in some areas to exclude cattle grazing and off-highway vehicle use. In addition to the lands that have been acquired by the Department, mitigation lands have also gone to the Desert Tortoise Preserve Committee.

In 2009, the Department spent significant time and resources on renewal energy projects. Work continued on permitting numerous small projects, which include mining activities, housing and other urban development, and road projects. The Department also

spent considerable time again this year working with Department of Defense on the Fort Irwin Expansion, reviewing mitigation lands, working to with the Fish and Wildlife Service to update the Desert Tortoise Handling Guidelines, permitting desert tortoise research projects, improving our methods for dealing with captive tortoises and working on subgroups of the Desert Managers Group on management and protection of the desert tortoise in California.

Fire and Invasive Species Impacts on Native Desert Annuals: Causes for Concern and Opportunities for Recovery

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Exotic annual species, like *Bromus* spp., *Schismus* spp., and *Erodium cicutarium*, have invaded low elevation creosote bush scrub in California and other portions of the American southwest. Exotic grasses, in particular, have exerted a strong influence on this vegetation by increasing the frequency and extent of fire, a disturbance that was historically very infrequent (Brooks and Esque 2002, Brooks et al. 2004). Sites that have been burned show little resiliency as dominant perennial species appear poorly adapted to fire (Brooks and Minnich 2006, Abella 2009). The impact of fire on native desert annuals is less understood (Brooks 2002). We were interested in the following questions pertaining to fire and annual plants; how does fire effect invasive and native annual species composition; how long do these impacts last for; and what is the impact of repeated fire? These questions were addressed by examining a series of burned creosote bush scrub stands from western Coachella Valley that ranged in time since fire from 3 to 29 years ago. In addition, a site containing portions unburned, once-burned, and twice-burned were also investigated. We found that shortly after fire, invasive species like *Erodium cicutarium* and *Schismus* spp. are promoted by fire while *Bromus madritensis* ssp. *rubens* and native annual species decline. Fires decreased native annual species richness, which was detected in burns ranging from 3 to 21 years old. The impact of repeated fire was especially severe, with decreased species richness occurring each time a stand burned. In general, fire promoted invasive annual plants and negatively impacted native annuals.

To tease apart the difference between fire impacts and invasive annual interference on native annual plants, invasive plant removal treatments were implemented in burned and unburned sites. Regardless of fire history, invasive species removal dramatically increased native annual species abundance and richness. Then, when comparing invasive removal plots in a burned site with invasive removal plots in an unburned, relatively "pristine" site with high regional species richness, the burned site exhibited native annual plant abundance and species richness equal to or greater than the "pristine" site. These results imply that native annuals, collectively, are highly resilient to fire if invasive species are not present. In other words, the general decline in native annual species richness that is common in creosote bush scrub after fire is more

attributable to invasive species competition rather than from fire itself. Competitive interference from invasive annual species appears to be a great threat to native annuals in both burned and unburned creosote bush scrub. Lastly, our invasive plant removal treatments revealed that a post-emergent herbicide, Fusilade II, is effective at killing both exotic grasses and *Erodium cicutarium* with minimal nontarget effects. If applied with discretion, this product appears to show promise as a valuable tool in the battle to control invasive species in desert landscapes.

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Response of Desert Tortoise Habitat, Populations, and Individuals to the 2005 Southern Nevada Complex Fire in Lincoln County, Nevada

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The Southern Nevada Complex fires of 2005 burned thousands of acres of desert tortoise (*Gopherus agassizii*) habitat in Lincoln County, NV. In 2008 and 2009, we assessed vegetation characteristics at burned and unburned sites by measuring shrub and herbaceous density, species richness, gap intercept, line-point intercept, and herbaceous production. Line Distance Sampling Transects were added in burned and unburned areas as well. Additionally, GPS transmitters were affixed to tortoises near the burned area to efficiently track individual movements. A variety of vegetation characteristics with consequences for desert tortoises differed in burned vs. unburned sites. Overall, species richness of plants palatable to desert tortoises was significantly lower at burned sites. Additionally, an increase in the percent cover and production of all herbaceous plants was observed at burned sites. While this suggests an increase in the quantity of food available to tortoises after fire, much of the increase is likely driven by one exotic forb, *Erodium cicutarium*, which was most prevalent at burned sites. Conversely, species richness and density of native plants, some of which are consumed by desert tortoises, were lower at burned sites. Finally, both species richness and percent cover of shrubs were lower and the spacing of shrubs was higher, at burned sites, which could have impacts on desert tortoise thermoregulation. Line Distance Sampling transects in burned and unburned

areas observed only ~2% of tortoises in burned areas. GPS data indicate tortoises in this study are using burned habitat and ~47% of tortoise home-range areas were burned.

An Introduction to the IUCN Red List of Threatened Species, and its Application to the Desert Tortoise

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This presentation will give a quick overview of the aims of the IUCN Red List of Threatened Species, the criteria determining a species' assessment, the assessment process, and the wider implications of Red List status, using the Desert Tortoise as an example. Much more detail than can be provided in this presentation is available at http://iucnredlist.org, particularly http://iucnredlist.org/technical-documents/categories-and-criteria and http://iucnredlist.org/technical-documents/assessment-process.

The Desert Tortoise (*Gopherus agassizii*) in Mexico, Project Update

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Approximately 40% of the desert tortoise's (*Gopherus agassizii*) geographic range is in northwestern Mexico, yet little is known of the species south of the border. Starting in 2001, we initiated collaborative international efforts involving researchers, agencies, tortoise field biologists, and local citizens to acquire baseline data on tortoise ecology, status, and conservation biology in Mexico. In 2001-2002 we documented a major mortality event on and near Tiburón Island. In 2005-2006 we sampled near Alamos (tropical deciduous forest,TDF), Hermosillo (Sonoran desertscrub), and Obrégon (foothill thornscrub), capturing 63 tortoises, as well as telemetering 19 in the TDF. Disease analysis, which also included 22 captive tortoises, indicated that all but one of the wild tortoises were negative for *Mycoplasma*, whereas 17 of the captives were positive or suspected positive. During 2007-2009, we maintained telemetric monitoring at Alamos. We continued extensive sampling during 2008 and 2009, focusing in Sinaloa where the

currently known southern range limit (Topolobampo, Sinaloa) is found, and on the genetic-morphological-ecological transition zone in eastern and southern Sonora. There is concordance of morphology and genetics with the subtropical (desertscrub plus thornscrub) - tropical TDF transition, but these concordances appear imperfect and potentially complex. We found 39 additional tortoises, and still remain to clearly confirm the presence of *Mycoplasma* and related disease in the wild in Mexico. Based on 16 microsatellite loci and ~1200 bp of the mitochondrial ND4 gene, we identified two genotypes in Sonora; one in desertscrub and thornscrub resembling the Arizona type ("Sonoran") and a second notably associated with TDF ("Sinaloan"). Sinaloan samples showed elevated genetic variation. We estimate this Sinaloan type diverged 5-6 mya from a common ancestor with the Sonoran and Mojave lineages. Spatial overlap of several genotypes at the southern boundary of Sonoran Desert scrub may be the result of a natural species friction zone, human translocation or possibly isolation prior to the formation of the Sonoran Desert. Two key conservation problems are likely affecting this tortoise in Mexico—climate-driven mortality episodes and intensified fire regimes associated with type conversion from native vegetation to Africanized buffelgrass pasture. The Tiburón mortality episode was associated with drought, as also observed in southern Arizona Sonoran Desert. Although precise causes of such episodes remain to be rigorously demonstrated, apparent associations with heat and drought foreshadow tortoise declines if current climate change predictions prove correct. We have limited observations of tortoises in buffelgrass-thornscrub landscapes, but plan to expand upon published observations suggesting that type conversion may decimate tortoise populations.

Antigenic Variation in *Mycoplasma agassizii* and Distinct Host Immune Antibody Responses Explain Differences Between ELISA and Western Blot Assays

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Due to the precarious status of desert (*Gopherus agassizii*) and gopher (*G. polyphemus*) tortoises, conservation efforts typically include health assessment as an important component of management decision-making and often may be the determining factor for translocation of animals. Mycoplasmal upper respiratory tract disease (URTD) is one of very few diseases in chelonians for which comprehensive and rigorously validated diagnostic tests exist. Recently, it has been suggested that the ELISA for detection of *M. agassizii* misidentified negative animals as seropositive and that Western blot analysis was a more reliable test. We present data that demonstrates that the failure to detect immunoreactive bands to *M. agassizii* strain PS6 in Western blots from selected ELISA-positive tortoises is most likely a result of the failure to use multiple *M. agassizii* strains as antigens in the Western blot.

In this study, sera and clinical isolates of *M. agassizii* were obtained from eight *Gopherus* tortoises documented at necropsy to be (i) ELISA seropositive, (ii) infected with *M. agassizii* as indicated by direct isolation of the pathogen from the respiratory surfaces, and (iii) to have histological lesions of URTD. We selected four clinical isolates of *M. agassizii* (strains PS6, 723, IR, and 262) for preparation of SDS PAGE and ELISA antigen**.** We also compared the reactivity of tortoise sera in an ELISA in which different strains of *M. agassizii* were used as antigen. Sera from tortoises were tested for the ability to recognize antigens prepared from heterologous as well as homologous strains of *M. agassizii* by both EISA and Western blot.

Serum from all eight tortoises reacted with *M. agassizii* strain PS6 when used as the ELISA antigen, but only 6 of 8 (75%) sera had strong banding patterns against *M. agassizii* strain PS6. All tortoises reacted by Western blot with SDS PAGE antigens prepared with the homologous strain of *M. agassizii*, but unlike the ELISA, reactions with SDS PAGE antigens prepared from heterologous clinical isolates varied markedly. For many mycoplasma species, detection of specific antibodies by ELISA is considered to be relatively strain-independent, whereas other assays such as Western blot, metabolic inhibition, and complement fixation assays are documented to be strain-dependent or best used for confirmation. These differences are likely explained by the location of the antigens (surface exposed, membrane or cytosolic), binding affinity to microtiter plates, degree of surface variation, biofunctional assays, and *in vivo* expression of antigens.

The ability of clinical isolates of most mycoplasma species to express different surface proteins, the variability in host immune recognition of antigenic determinants, and the need for multiple mycoplasma strains as antigens in Western blot analysis of naturally infected animals is well documented in the literature. In our study, individual variation in the immune response among animals, even to the same strain of *M. agassizii*, was common in Western blot. We observed similar heterogeneity in the response of individual animals to *M. agassizzi*, with antigens prepared from both the homologous strain recovered from the individual as well as from heterologous strains. Even in animals documented by the most rigorous methods to have current active URTD, Western blot using a single antigen failed to detect true positive animals in 25% of cases, whereas ELISA reliably detected all animals proven to have URTD.

The American West at Risk: Science, Myths, and Politics of Land Abuse and Recovery

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The American West at Risk: Science Myths, and Politics of Land Abuse and Recovery, speaks to rising public concerns over environmental calamities echoed in our national headlines, and offers ways to combat the damages. The text illuminates how the western United States reached a state of resource depletion, along with extensive land,

water and air pollution, and species extinctions. Especially in the Western U.S., land misuse and overuse have created a serious crisis.

Southern California suffers from multiple legacies of land abuse, principally misguided grazing and farming practices, military training, reckless urbanization, unbridled mechanized recreation, and exploration for and exploitation of energy and metallic minerals. Massive wastes--the nation's number one product--either created in the desert or disposed of there, include Cold War pollution from both training and weapons tests, both radioactive and not, and the urban garbage overflow. After describing the book's origin, purpose and objectives, we will detail the rapidly accelerating threats and potential consequences of locating utility-scale solar and wind power plants in our deserts, and discuss the best alternatives.

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Department of Defense and Desert Tortoise Conservation

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[4]NAWC China Lake, 1 Administration Circle, NAWC China Lake, CA 93555
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Military installations face many challenges just as other land management agencies. Desert tortoise (*Gopherus agassizii*) populations continue to decline on military bases. Predation by common ravens, coyotes, and domestic dogs has an effect on desert tortoise populations. Military bases must employ ecosystem management principles and manage their lands for multiple uses and military missions. Department of Defense (DoD) installations in the western Mojave Desert initiated and continued many conservation programs for the desert tortoise in 2009. Conservation measures covered a broad spectrum at each installation including education and outreach, research, and other projects to manage the species and habitats. DoD installations also participated in the Desert Managers Group, associated workgroups, and the Desert Tortoise Management Oversight Group, to support recovery planning and action. Projects such as head starting are designed to increase populations and enhance recovery efforts and can be exported to areas beyond installation borders. Some of our research projects have broad applications beyond the boundaries of the military installations. Research projects include disease studies, population monitoring and demographic research, predator research, and head starting. Public outreach and education of base personnel continue to be important programs at military installations. These efforts involve presenting programs in schools, education of military and civilian workforce to supporting public outreach activities in

local communities. Desert tortoise conservation efforts involve a significant commitment of resources within our environmental offices and throughout the installations.